BCS 511 Minilab 2 - Psychophysics: Sex-related differences in motion processing?

Ying Lin
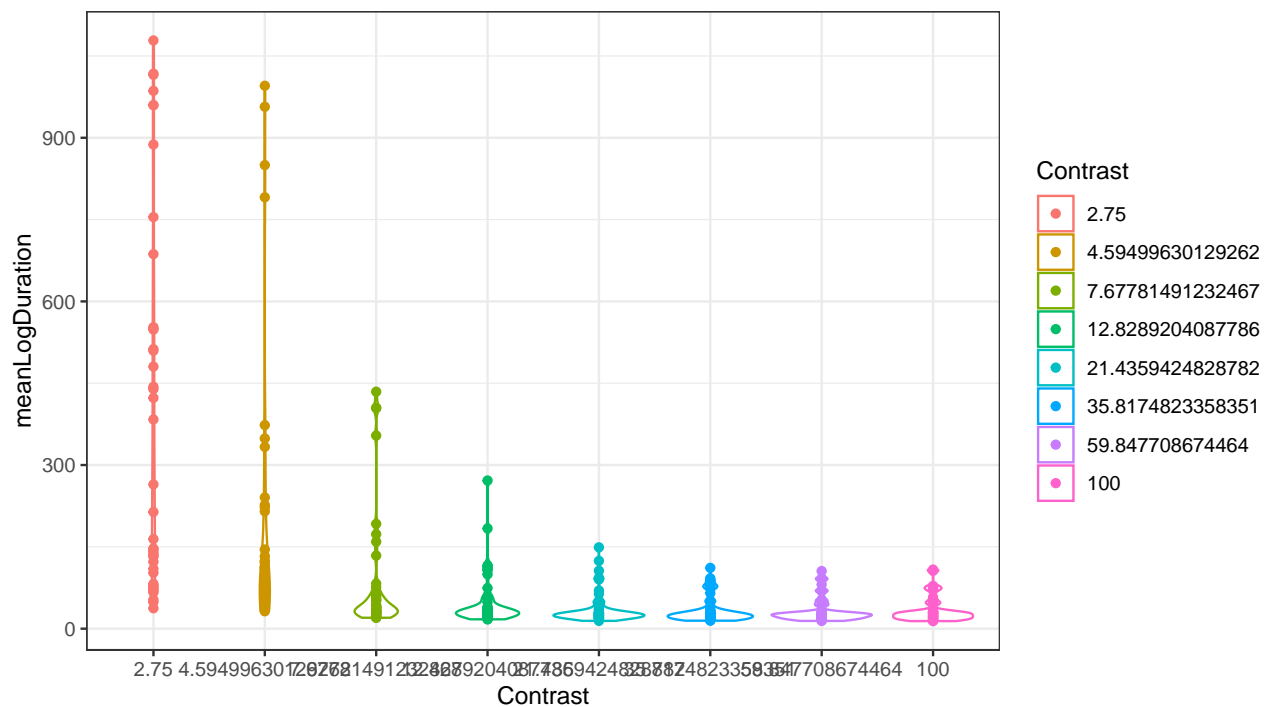
11/1/2019

1. Descriptive plots and analysis

Visualization of duration threshold and the other parameters (*Rmax*, *Slope*, and *C50*). Analyzed sex-related effects of all parameters using *t-test*
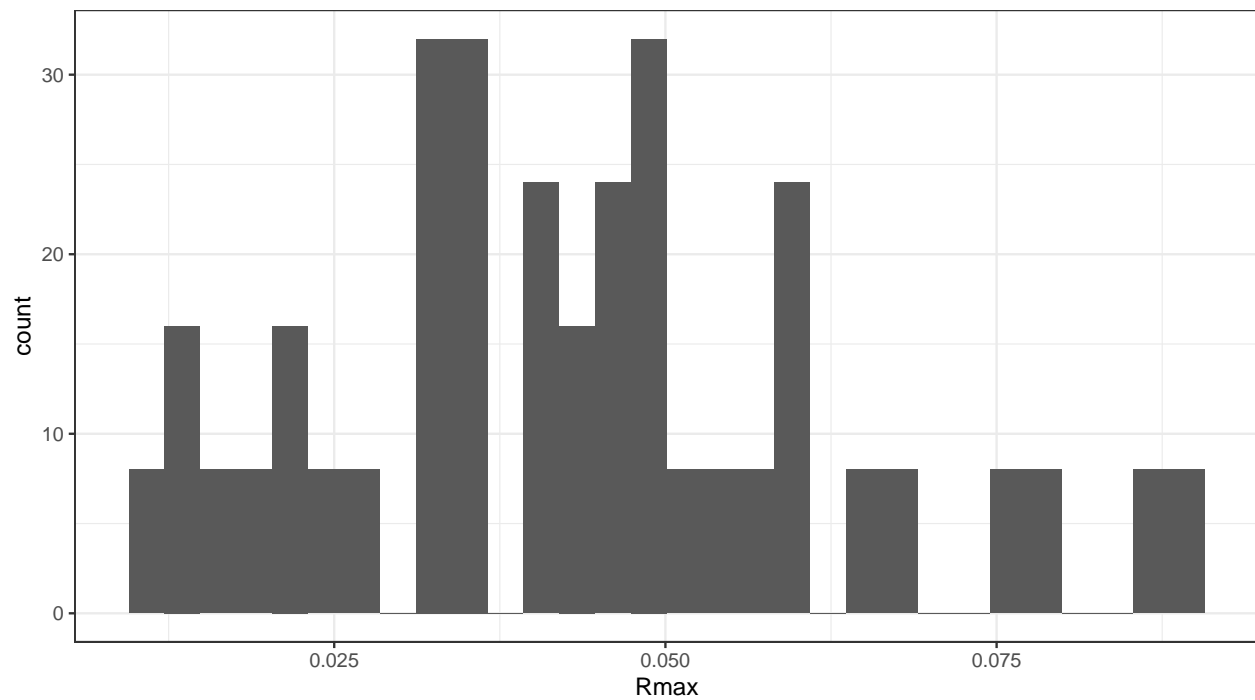
We found that the effect of gender for all parameters were significant.

```
# violin plot of mean of LogDuration
ggplot(d.summary, aes(x = Contrast, y = meanLogDuration, color=Contrast)) +
  geom_violin() + geom_point()
```
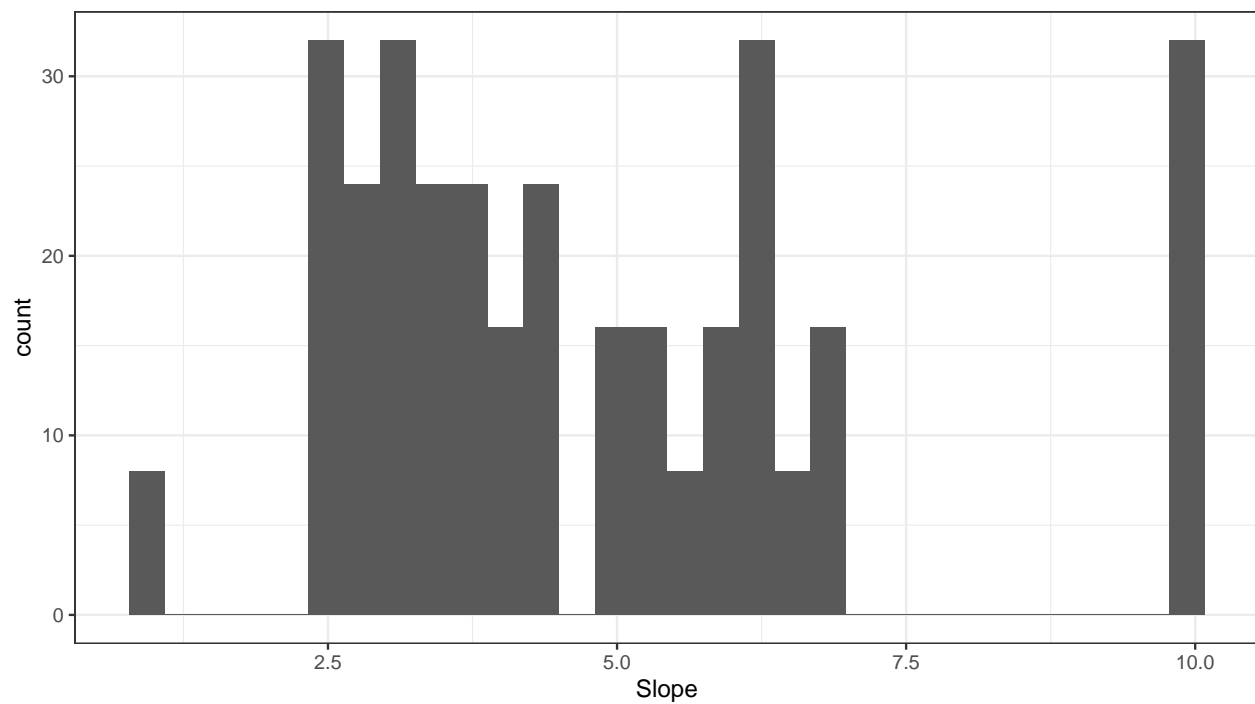


```
# histogram plot for parameters: Rmax, Slope, C50
ggplot(d.summary, aes(x = Rmax)) + geom_histogram()
```

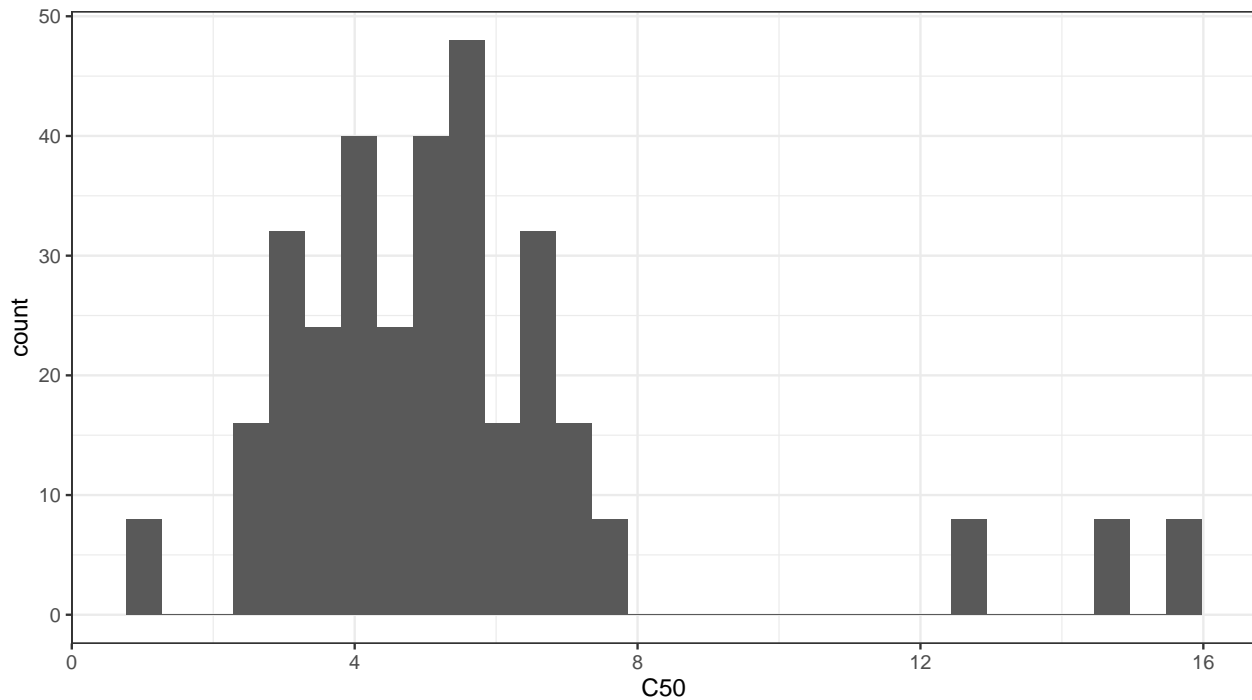`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.

```
ggplot(d.summary, aes(x = Slope)) +geom_histogram()
```

`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.


```
ggplot(d.summary, aes(x = C50)) +  geom_histogram()
```

`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.

T-tests: comparing effects of gender on LogDuration, Rmax, Slope, and C50

We found a significant gender difference of duration threshold ($\hat{\beta} = 2.67$, $t = 0.67$, $p < 0.05$)

```
# t-tests
t.test(data = d, LogDuration~as.factor(Sex))
```

```
	Welch Two Sample t-test

data:  LogDuration by as.factor(Sex)
t = 0.67164, df = 16139, p-value = 0.5018
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -5.137085 10.492666
sample estimates:
mean in group 0 mean in group 1
       107.6143        104.9365
```

```
t.test(data = d, Rmax~as.factor(Sex))
```

```
	Welch Two Sample t-test

data:  Rmax by as.factor(Sex)
t = 89.874, df = 16377, p-value < 2.2e-16
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
```

```
  0.02131193 0.02226225
sample estimates:
mean in group 0 mean in group 1
     0.05427736      0.03249027
```

```
t.test(data = d, Slope~as.factor(Sex))
```

```
	Welch Two Sample t-test

data:  Slope by as.factor(Sex)
t = -21.047, df = 15409, p-value < 2.2e-16
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.7902836 -0.6556250
sample estimates:
mean in group 0 mean in group 1
      4.468782       5.191737
```

```
t.test(data = d, C50~as.factor(Sex))
```

```
	Welch Two Sample t-test

data:  C50 by as.factor(Sex)
t = 50.27, df = 11260, p-value < 2.2e-16
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 2.006951 2.169816
sample estimates:
mean in group 0 mean in group 1
      6.523592       4.435209
```

2. Using alternative measures of parameter Rmax and C50 (*Asymp* and *LogAsymp* instead of *Rmax*; and *LogC50* instead of *C50*)

```
# t-tests
t.test(data = d, Asymp~as.factor(Sex))
```

```
	Welch Two Sample t-test

data:  Asymp by as.factor(Sex)
t = -83.212, df = 8966.4, p-value < 2.2e-16
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -19.76626 -18.85643
sample estimates:
mean in group 0 mean in group 1
      19.82583       39.13717
```

```r
t.test(data = d, LogAsymp~as.factor(Sex))
```

```
	Welch Two Sample t-test

data:  LogAsymp by as.factor(Sex)
t = 8.1133, df = 14951, p-value = 5.307e-16
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 0.1321487 0.2163418
sample estimates:
mean in group 0 mean in group 1
       2.453379        2.279134
```

```r
t.test(data = d, LogC50~as.factor(Sex))
```

```
	Welch Two Sample t-test

data:  LogC50 by as.factor(Sex)
t = -94.408, df = 12288, p-value < 2.2e-16
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.2623399 -0.2516678
sample estimates:
mean in group 0 mean in group 1
       1.281933        1.538937
```

```r
# extracting cross subject mean of parameters
d.crossub = d %>%
  group_by(Subject) %>%
  summarise(Rmax = mean(Rmax), Slope = mean(Slope), C50=mean(C50), Sex = mean(Sex))


# t-tests of paramater after filtering out +/- 3SD of mean

# d.sd_dur = d.crossub %>%
#   filter(abs(LogDuration) < 3*sd(LogDuration)+mean(LogDuration))
#
# t.test(data = d.sd_dur, LogDuration~as.factor(Sex))
#
# d.sd_rmax = d.crossub %>%
#   (abs(d.crossub$Rmax) < 3*std(d.crossub$Rmax)+mean(d.crossub$Rmax))
#
# t.test(data = d.sd_rmax, Rmax~as.factor(Sex))


d.sd_slope = d.crossub %>%
  filter(Slope < 3*sd(Slope))


t.test(data = d.sd_slope, Slope~as.factor(Sex))
```

```
    Welch Two Sample t-test

data:  Slope by as.factor(Sex)
t = -0.93483, df = 32.499, p-value = 0.3568
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -1.4288365  0.5295249
sample estimates:
mean in group 0 mean in group 1
       3.893740        4.343396
```

```r
d.sd_c50 = d.crossub %>%
  filter(C50 < 3*sd(C50))

t.test(data = d.sd_c50, C50~as.factor(Sex))
```

```
    Welch Two Sample t-test

data:  C50 by as.factor(Sex)
t = 1.6304, df = 35.786, p-value = 0.1118
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.1880461  1.7280557
sample estimates:
mean in group 0 mean in group 1
       5.205214        4.435209
```

References

- Wheelwright, S., Baron-Cohen, S., Goldenfeld, N., Delaney, J., Fine, D., Smith, R., … & Wakabayashi, A., 2006). Predicting autism spectrum quotient (AQ) from the systemizing quotient-revised (SQ-R) and empathy quotient (EQ). Brain research, 1079(1), 47-56

Session info

```
## - Session info ------------------------------------------------------------------------------
##  setting  value
##  version  R version 3.6.1 (2019-07-05)
##  os       macOS High Sierra 10.13.6
##  system   x86_64, darwin15.6.0
##  ui       X11
##  language (EN)
##  collate  en_US.UTF-8
##  ctype    en_US.UTF-8
##  tz       America/New_York
##  date     2019-11-13
##
## - Packages ----------------------------------------------------------------------------------
```

```
##    package        * version   date       lib source
##    abind            1.4-5     2016-07-21 [1] CRAN (R 3.6.0)
##    assertthat       0.2.1     2019-03-21 [1] CRAN (R 3.6.0)
##    backports        1.1.4     2019-04-10 [2] CRAN (R 3.6.0)
##    base64enc        0.1-3     2015-07-28 [2] CRAN (R 3.6.0)
##    bayesplot        1.7.0     2019-05-23 [1] CRAN (R 3.6.0)
##    boot             1.3-22    2019-04-02 [2] CRAN (R 3.6.1)
##    bridgesampling   0.7-2     2019-07-21 [1] CRAN (R 3.6.0)
##    brms           * 2.10.0    2019-08-29 [1] CRAN (R 3.6.0)
##    Brobdingnag      1.2-6     2018-08-13 [1] CRAN (R 3.6.0)
##    broom          * 0.5.2     2019-04-07 [1] CRAN (R 3.6.0)
##    callr            3.3.1     2019-07-18 [2] CRAN (R 3.6.0)
##    cellranger       1.1.0     2016-07-27 [2] CRAN (R 3.6.0)
##    cli              1.1.0     2019-03-19 [2] CRAN (R 3.6.0)
##    coda             0.19-3    2019-07-05 [1] CRAN (R 3.6.0)
##    colorspace       1.4-1     2019-03-18 [2] CRAN (R 3.6.0)
##    colourpicker     1.0       2017-09-27 [1] CRAN (R 3.6.0)
##    crayon           1.3.4     2017-09-16 [2] CRAN (R 3.6.0)
##    crosstalk        1.0.0     2016-12-21 [1] CRAN (R 3.6.0)
##    desc             1.2.0     2018-05-01 [1] CRAN (R 3.6.0)
##    devtools         2.2.0     2019-09-07 [1] CRAN (R 3.6.0)
##    digest           0.6.20    2019-07-04 [2] CRAN (R 3.6.0)
##    dplyr          * 0.8.3     2019-07-04 [1] CRAN (R 3.6.0)
##    DT               0.8       2019-08-07 [1] CRAN (R 3.6.0)
##    dygraphs         1.1.1.6   2018-07-11 [1] CRAN (R 3.6.0)
##    ellipsis         0.2.0.1   2019-07-02 [2] CRAN (R 3.6.0)
##    evaluate         0.14      2019-05-28 [2] CRAN (R 3.6.0)
##    forcats        * 0.4.0     2019-02-17 [2] CRAN (R 3.6.0)
##    fs               1.3.1     2019-05-06 [2] CRAN (R 3.6.0)
##    generics         0.0.2     2018-11-29 [2] CRAN (R 3.6.0)
##    ggeffects      * 0.12.0    2019-09-03 [1] CRAN (R 3.6.0)
##    ggplot2        * 3.2.1     2019-08-10 [2] CRAN (R 3.6.0)
##    ggridges         0.5.1     2018-09-27 [1] CRAN (R 3.6.0)
##    glue             1.3.1     2019-03-12 [2] CRAN (R 3.6.0)
##    gridExtra        2.3       2017-09-09 [2] CRAN (R 3.6.0)
##    gtable           0.3.0     2019-03-25 [2] CRAN (R 3.6.0)
##    gtools           3.8.1     2018-06-26 [1] CRAN (R 3.6.0)
##    haven            2.1.1     2019-07-04 [2] CRAN (R 3.6.0)
##    hms              0.5.1     2019-08-23 [2] CRAN (R 3.6.0)
##    htmltools        0.3.6     2017-04-28 [2] CRAN (R 3.6.0)
##    htmlwidgets      1.3       2018-09-30 [1] CRAN (R 3.6.0)
##    httpuv           1.5.1     2019-04-05 [1] CRAN (R 3.6.0)
##    httr             1.4.1     2019-08-05 [2] CRAN (R 3.6.0)
##    igraph           1.2.4.1   2019-04-22 [1] CRAN (R 3.6.0)
##    inline           0.3.15    2018-05-18 [1] CRAN (R 3.6.0)
##    insight          0.5.0     2019-09-07 [1] CRAN (R 3.6.0)
##    jsonlite         1.6       2018-12-07 [2] CRAN (R 3.6.0)
##    knitr            1.24      2019-08-08 [2] CRAN (R 3.6.0)
##    labeling         0.3       2014-08-23 [2] CRAN (R 3.6.0)
##    later            0.8.0     2019-02-11 [1] CRAN (R 3.6.0)
##    lattice          0.20-38   2018-11-04 [2] CRAN (R 3.6.1)
##    lazyeval         0.2.2     2019-03-15 [2] CRAN (R 3.6.0)
##    lifecycle        0.1.0     2019-08-01 [1] CRAN (R 3.6.0)
##    lme4           * 1.1-21    2019-03-05 [1] CRAN (R 3.6.0)
```

```
## lmerTest    * 3.1-0      2019-02-11 [1] CRAN (R 3.6.0)
## loo           2.1.0      2019-03-13 [1] CRAN (R 3.6.0)
## lubridate     1.7.4      2018-04-11 [2] CRAN (R 3.6.0)
## magrittr    * 1.5        2014-11-22 [1] CRAN (R 3.6.0)
## markdown      1.1        2019-08-07 [2] CRAN (R 3.6.0)
## MASS          7.3-51.4   2019-03-31 [2] CRAN (R 3.6.1)
## Matrix      * 1.2-17     2019-03-22 [2] CRAN (R 3.6.1)
## matrixStats   0.55.0     2019-09-07 [1] CRAN (R 3.6.0)
## memoise       1.1.0      2017-04-21 [1] CRAN (R 3.6.0)
## mime          0.7        2019-06-11 [2] CRAN (R 3.6.0)
## miniUI        0.1.1.1    2018-05-18 [1] CRAN (R 3.6.0)
## minqa         1.2.4      2014-10-09 [1] CRAN (R 3.6.0)
## modelr        0.1.5      2019-08-08 [2] CRAN (R 3.6.0)
## munsell       0.5.0      2018-06-12 [2] CRAN (R 3.6.0)
## nlme          3.1-140    2019-05-12 [2] CRAN (R 3.6.1)
## nloptr        1.2.1      2018-10-03 [1] CRAN (R 3.6.0)
## numDeriv      2016.8-1.1 2019-06-06 [1] CRAN (R 3.6.0)
## pillar        1.4.2      2019-06-29 [2] CRAN (R 3.6.0)
## pkgbuild      1.0.5      2019-08-26 [1] CRAN (R 3.6.0)
## pkgconfig     2.0.2      2018-08-16 [2] CRAN (R 3.6.0)
## pkgload       1.0.2      2018-10-29 [1] CRAN (R 3.6.0)
## plyr          1.8.4      2016-06-08 [2] CRAN (R 3.6.0)
## prettyunits   1.0.2      2015-07-13 [2] CRAN (R 3.6.0)
## processx      3.4.1      2019-07-18 [2] CRAN (R 3.6.0)
## promises      1.0.1      2018-04-13 [1] CRAN (R 3.6.0)
## ps            1.3.0      2018-12-21 [2] CRAN (R 3.6.0)
## purrr       * 0.3.2      2019-03-15 [1] CRAN (R 3.6.0)
## R6            2.4.0      2019-02-14 [2] CRAN (R 3.6.0)
## Rcpp        * 1.0.2      2019-07-25 [2] CRAN (R 3.6.0)
## readr       * 1.3.1      2018-12-21 [2] CRAN (R 3.6.0)
## readxl        1.3.1      2019-03-13 [2] CRAN (R 3.6.0)
## remotes       2.1.0      2019-06-24 [1] CRAN (R 3.6.0)
## reshape2      1.4.3      2017-12-11 [2] CRAN (R 3.6.0)
## rlang         0.4.0      2019-06-25 [2] CRAN (R 3.6.0)
## rmarkdown     1.15       2019-08-21 [2] CRAN (R 3.6.0)
## rprojroot     1.3-2      2018-01-03 [2] CRAN (R 3.6.0)
## rsconnect     0.8.15     2019-07-22 [1] CRAN (R 3.6.0)
## rstan         2.19.2     2019-07-09 [1] CRAN (R 3.6.0)
## rstantools    1.5.1      2018-08-22 [1] CRAN (R 3.6.0)
## rstudioapi    0.10       2019-03-19 [2] CRAN (R 3.6.0)
## rvest         0.3.4      2019-05-15 [2] CRAN (R 3.6.0)
## scales        1.0.0      2018-08-09 [2] CRAN (R 3.6.0)
## sessioninfo   1.1.1      2018-11-05 [1] CRAN (R 3.6.0)
## shiny         1.3.2      2019-04-22 [1] CRAN (R 3.6.0)
## shinyjs       1.0        2018-01-08 [1] CRAN (R 3.6.0)
## shinystan     2.5.0      2018-05-01 [1] CRAN (R 3.6.0)
## shinythemes   1.1.2      2018-11-06 [1] CRAN (R 3.6.0)
## sjlabelled    1.1.0      2019-06-06 [1] CRAN (R 3.6.0)
## sjmisc        2.8.1      2019-06-17 [1] CRAN (R 3.6.0)
## StanHeaders   2.19.0     2019-09-07 [1] CRAN (R 3.6.0)
## stringi       1.4.3      2019-03-12 [2] CRAN (R 3.6.0)
## stringr     * 1.4.0      2019-02-10 [2] CRAN (R 3.6.0)
## testthat      2.2.1      2019-07-25 [1] CRAN (R 3.6.0)
## threejs       0.3.1      2017-08-13 [1] CRAN (R 3.6.0)
```

```
##   tibble       * 2.1.3    2019-06-06 [2] CRAN (R 3.6.0)
##   tidyr        * 1.0.0    2019-09-11 [1] CRAN (R 3.6.0)
##   tidyselect     0.2.5    2018-10-11 [2] CRAN (R 3.6.0)
##   tidyverse    * 1.2.1    2017-11-14 [2] CRAN (R 3.6.0)
##   usethis        1.5.1    2019-07-04 [1] CRAN (R 3.6.0)
##   vctrs          0.2.0    2019-07-05 [2] CRAN (R 3.6.0)
##   withr          2.1.2    2018-03-15 [2] CRAN (R 3.6.0)
##   xfun           0.9      2019-08-21 [2] CRAN (R 3.6.0)
##   xml2           1.2.2    2019-08-09 [2] CRAN (R 3.6.0)
##   xtable         1.8-4    2019-04-21 [1] CRAN (R 3.6.0)
##   xts            0.11-2   2018-11-05 [1] CRAN (R 3.6.0)
##   yaml           2.2.0    2018-07-25 [2] CRAN (R 3.6.0)
##   zeallot        0.1.0    2018-01-28 [2] CRAN (R 3.6.0)
##   zoo            1.8-6    2019-05-28 [1] CRAN (R 3.6.0)
##
## [1] /Users/yinglin/Library/R/3.6/library
## [2] /Library/Frameworks/R.framework/Versions/3.6/Resources/library
```